BECHT
ENGINEERING COMPANY, INC.

TOTAL SYSTEMS ENGINEERING SERVICE

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March 24, 1993

cc: Jim C ✓
Andy
Dennis
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K. Hovnanian Companies, Inc.
10 Highway #35
PO Box 500
Red Bank, New Jersey 07701

Attention: Mr. Dennis Fitzgerald

Reference: Paddington Square Condominium
Plumbing and HVAC Investigation
Our Project Number 932629

Gentlemen:

The office of Becht Engineering Company was engaged by K. Hovnanian Companies to investigate the reported freezing plumbing pipes and heat loss problems, and to recommend corrective procedures at Paddington Square Condominium in Mahwah, New Jersey.

The initial site investigations were held on February 19 and 25, 1993, by Thomas Gilleran, Russell Fernandes, and Charles Becht, PE, of Becht Engineering Company, in the presence of Dennis Fitzgerald of K. Hovnanian Companies. Continuing site inspections are being performed by Sean Turnquist of the Becht firm under the supervision of Charles Becht, PE. These site inspections were conducted between February 19 and March 22, 1993. A list of units and the dates they were inspected is included at the end of this report. 11-90 (first closing)

Paddington Square Condominium is a 3 to 4 (1 to 3) year old condominium and townhouse complex located in northern New Jersey. The site is located on open hilly terrain. The complex consists of 39 buildings containing 500+ units. The architectural style can be labeled as being "California" or "Southwest" influenced, (i.e large areas of glass, cathedral ceilings, large roof areas with overhangs, rooms with three or more exposures, etc.). There were three primary areas of concern pertaining to the insulation and construction as expressed by Dennis Fitzgerald during initial discussions. These were (1) at the second floor band joist framing, (2) at the first floor kitchen box window with a large ventilated roof overhang, and (3) at the fireplace chase for the first floor, which is located on an exterior wall.

The architectural style and design of the buildings are contributing to the problems that are occurring at Paddington Square, both in the freezing of the piping and the uneven heating of the units. The architecture has many "ins and outs" with rooms (bathrooms and bedrooms) that are exposed to exterior walls on as many as three sides and that are above unheated garage spaces. These rooms will cool down quicker than other interior areas due to the extent of their exposure. Additionally, the meter closets and fireplace chases are near the kitchens where domestic water supplies are run. As noted, these chases are not well insulated.

The second floor framing consists of an open web truss system. This truss system has a depth of approximately 16 inches. The first floor ceiling is constructed of two layers of gypsum wallboard separated by resilient steel channels. The ceiling is insulated with one layer of R-11 batt insulation. The second floor is constructed of 3/4" Gypcrete on a 3/4" tongue and groove oxboard subfloor. There is no insulation on the underside of the floor. The exterior wall construction at the band joist area consists of 2" x 4" wood trusses, covered with 1/2" plywood sheathing, one layer of Dupont Tyvek house wrap, and 1/2" x 4" horizontal wood siding. The 2" x 4" truss cavity is insulated with either R-13 or R-11 batt insulation. There were many examples of holes in the plywood sheathing, some of which were repaired to the very minimum and others which were left unattended (see photograph at end of report). At the plywood seam sections there were many examples of cracks and spaces greater than 1/4". These cracks were not sealed with any type of insulation.

The insulation was not cut to fit tightly in the truss areas (see photograph at end of report). The architectural plans specified an insulation factor of R-13 on all exterior walls. However, there were many examples of R-11 being used. The Tyvek material was not installed to the manufacturer's specifications. The manufacturer recommends pulling the Tyvek tight to eliminate all excess slack, overlapping the seams by eight inches and installing the Tyvek with the writing side facing the exterior of the building. There were examples of excess slack in the Tyvek and the minimum overlap not being met. The gas meter closet on Building #4, Unit 1508 had the Tyvek installed with the writing on the wrong side (see photograph at end of report). Due to the extreme weather conditions, quality of workmanship and architectural style at the site, large quantities of outside air were infiltrating into the truss areas. See the air infiltration calculation on pages 7, 8, and 9 for differences of tight construction vs. poor construction.

Also, due to the fact that the trusses are the open web type, air that is infiltrating the truss cavity flows to other areas of the building. There is no way to confine the air flow through the trusses.

These conditions caused freezing water pipes in the ceiling cavity and an excessive heat loss in the rooms on the perimeter of the buildings. The first floor of unit type GH 750-P, which has a fireplace chase and gas meter closet on an exterior wall, and second floor unit type GH 1650-P, which has a cathedral ceiling and a fireplace chase located on an exterior wall, were the most prone to freezing conditions. Also, the sprinkler piping is run in unheated roof rafter locations. Sprinkler heads are, in some cases, approximately 5 to 10 feet away from the vented soffit, and thus are subjected to freezing conditions.

The corrective procedures we recommend are: removing all siding, Tyvek, sheathing, and insulation in the band joist area, installing two layers of R-19 batt insulation on top of the existing R-11 ceiling insulation, approximately 24" into the open truss area, and then placing another layer of R-13 insulation in the vertical position on the exterior wall. The new insulation value for this area is R-72. See SK-1 at the end of this report for details.

All sheathing and siding are to be replaced as original. All sheathing with holes are to be replaced with new 1/2" sheathing and all large cracks are to be sealed with expanding foam insulation or covered with heavy duty contractors tape. All Tyvek seams and overlaps are also to be sealed with contractors tape.

The second area of concern, which is typical in unit type TPGH 900-P, is where a kitchen box window with a large ventilated roof area covers an interior space. See SK-2 for details. Two thirds of the kitchen is covered by the second floor and one third is covered by a roof soffit. The soffit is ventilated and outside air enters into the roof cavity above the kitchen. The architectural plans require an insulation value of R-38 minimum above all interior ceilings that are adjacent to a roof or an attic. There were instances of no insulation above the kitchen. The plywood sheathing that protects the second floor truss was either missing or improperly nailed. In cases where the plywood was missing combined with no insulation, the outside air could freely flow into the entire truss area, thus reducing the temperature of the entire cavity to outdoor temperature.

To remedy this problem, we recommend removing the soffit panel to provide access to the roof cavity. A knee wall should be built from the cantilevered ceiling joist and attached to the existing roof rafters. The knee wall would be covered with 1/2" sheathing

and one layer of Tyvek. The sheathing should be 1/2" to 1" below the bottom of the roof sheathing to provide ventilation to the roof cavity. The ceiling exposed to the roof area would be insulated with an R-70 value. The existing soffit vents would then be re-installed as original. Reducing the amount of soffit ventilation is not required. The new knee wall will reduce the ventilation in the attic space by its construction. See SK-2 for details. Again, all Tyvek overlaps, plywood seams, and other areas of air infiltration would either be taped or sealed with expanding foam insulation to ensure a tight construction procedure.

The third area of concern is the wind infiltration through the first floor fireplace chase and chimney flue penetrations. Not all condominium and townhouse units have a fireplace. Units without a fireplace were repaired as per detail SK-1. The fireplace assembly has a natural gas ignition system and consists of a steel firebox with a 12" double wall type "B" metal chimney. The fireplace chase is located on an exterior wall. The fireplace flue for the first floor unit extends diagonally into the exterior chase in the second floor band joist. This band joist area is open to the uninsulated fireplace chase. With the existing condition, there is no means to prevent cold air from entering into the floor truss area (see photographs at the end of this report).

Due to this type of construction and the working space limitations, we recommend correcting the fireplace flue construction by either one of two methods. The first and preferred method, if work space permits, is to "box out" the flue in the floor truss area by securing 5/8" type "X" gypsum wallboard to the existing trusses. The "boxed out" area would then be insulated with an approved fire resistant insulation, with care taken not to place any combustible material in contact with the flue. See SK-3 for details. The second method, if work space is limited, is to isolate the chase from the floor truss area. This would be accomplished by modifying a 5/8" piece of type "X" fireproof gypsum wallboard to fit around the flue and fastening the wallboard to the truss area where the flue extends into the chase. Care must be taken to keep combustible materials away from the flue. The clearance space between the type "X" wallboard and flue would be insulated with fire resistant insulation. See SK-4 for details. Access to the chase must be achieved by removing the exterior siding and sheathing. Again, all Tyvek overlaps, plywood seams and other areas of air infiltration would be either taped or sealed with expanding foam insulation to ensure a tight construction procedure.

During our inspections, wherever plumbing pipes were located, special care was taken to ensure they were well insulated. See SK-5 for details. The domestic water supplies

are Type L copper pipe. The sanitary and vent piping are PVC. These pipes were run in unheated truss cavities and also over unheated garage spaces. Plumbing pipes were run in or near exterior walls with no insulation around them (see photograph at the end of this report). The sprinkler piping that froze and broke, in Units 1062 and 1044 Cambridge Ct., was located in a ventilated cathedral ceiling. The ceiling was ventilated correctly; however, piping subject to freezing should not be run in ventilated spaces that are subject to harsh weather conditions such is typical at Paddington Square without being well insulated.

Also, as per our inspection on February 25, 1993, and letter dated February 26, 1993, we noticed a damaged section of Blazemaster CPVC pipe was repaired with a gray colored pipe which had no markings to indicate that it was U.L. approved. It is possible that the new pipe piece is made of polybutylene that is similar to Blazemaster. However, polybutylene piping joints are heat sealed and would not be compatible to the glue joint system that is used with Blazemaster. The new piece of sprinkler pipe should be replaced with Blazemaster type to maintain the U.L. fire rating of the system.

During a subsequent inspection to examine the repaired sprinkler pipe, the access panel in the cathedral ceiling was already repaired and sealed. We recommend the installer submit to K. Hovnanian a specification on the newly installed pipe to determine if it is acceptable. If it is determined that the new pipe is polybutylene or PVC, it should be replaced with Blazemaster type.

Many unit owners complained about the heating system not working properly. Unit 1045 Cambridge Ct., which is a 1650 unit type, is heated by two means. The primary heat is supplied by a York gas fired furnace with a 105,000 Btuh input. As per our calculation, this furnace is of adequate size to heat the unit. The second method of heat is a York heat pump with a 17.1 MBH input. We are assuming the heat pump is used as an auxiliary heating source to be used when the outside temperature is in the 50°F to 65°F range and also for cooling. (Detailed information on the heating capacity of the remaining units was not available.) When we were at the site we noticed heat pumps were operating while the outside temperature was in the 30°F range. At this outside temperature, without electric resistance heating coils as backup, the air delivered by the heat pump would be cool, creating uncomfortable conditions in the residence.

Also, each unit is singularly zoned. A one heat zone design can present problems when installed in this type of architecture. Due to the different room exposures, each room will

experience different load conditions. Rooms with large East exposures will warm in the mornings, rooms with large West exposures will warm in the afternoon, and rooms with large North exposures will have a tendency to remain cool. In a unit that has many exposures with a first floor and loft floor in addition to a cathedral ceiling it is practically impossible to heat or cool comfortably with a single zone.

The ductwork is run in the second floor truss cavity. Due to the extreme temperature difference between the truss and the living space, the warm air flowing through the ductwork will cool down noticeably because it is not insulated. Also, in the attic of Unit 1045 Cambridge Ct., a section of flexible ductwork exceeded the 14 foot maximum length as dictated by BOCA Code.

In conclusion, we recommend performing the corrective work as described in this report in all buildings at the site. The corrective work includes re-insulating the second floor band joists, building a knee wall above the kitchen box windows and re-insulating all first floor fireplace chimney enclosures. In our opinion these improvements will alleviate the freezing plumbing pipe problems and improve the heating situation. It is also our opinion that the insulation installation was of subpar workmanship. As stated, there were many examples of poor fitting insulation, missing insulation, and improper R-value rating of insulation installed in walls.

Although the heating system will be improved due to reduced heat losses, even heating and cooling of the units is limited by the system types installed.

DRAFT

Charles Becht, PE, PP

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WIND INFILTRATION CALCULATIONS
BASED ON ASHRAE STANDARDS

DESIGN CRITERIA

	Wind Leakage Coefficient
Loose Fitting Wall	K = 1.30
Tight Fitting Wall	K = 0.22

Wind Velocity = 25 MPH
Wind Coefficient Factor, Cp = 0.95 (windward side)
Temperature difference (ΔT) between outside and truss cavity = 10°F (as existing)

$$\frac{\Delta Pw}{Cp} = 0.3 \quad (Fig.\ 1)$$

ΔPw = Cp x 0.3 = 0.95 x 0.3 = 0.285 inches of water

Neutral Z one = 5'

$$\frac{\Delta Ps}{Cd} = 0.00625 \quad (Fig.\ 2)$$

Cd = 0.82

ΔPs = Cd x 0.00625 = 0.82 x 0.00625 = 0.00513 inches of water
ΔP = ΔPw + ΔPs = 0.285 + 0.00513 = 0.290

From Fig. 3

Wind Infiltration in Loose Wall = 0.59 cfm/ft²
Wind Infiltration in Tight Wall = 0.1 cfm/ft²

Typical Band Joist Wall Area

393 ft/building
x 1.33 ft (floor truss depth)
523 sq ft/building

Loose Fitting Wall

(523 sq ft/building)(0.59 cfm/sq ft) = 308 cfm/building infiltration factor

Tight Fitting Wall

(523 sq ft/building(0.59 cfm/sq ft) = 53 cfm/building infiltration factor.

WIND INFILTRATION DATA

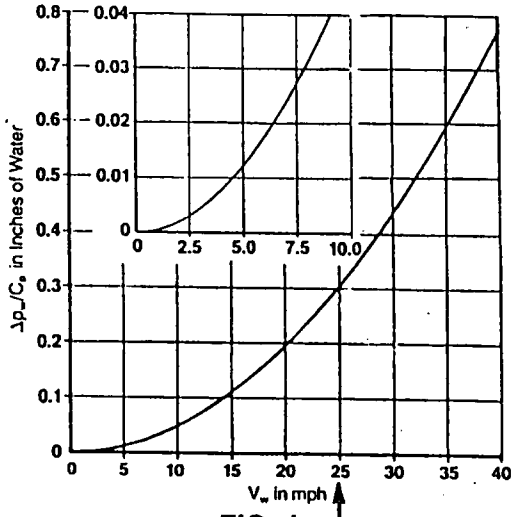

FIG. 1

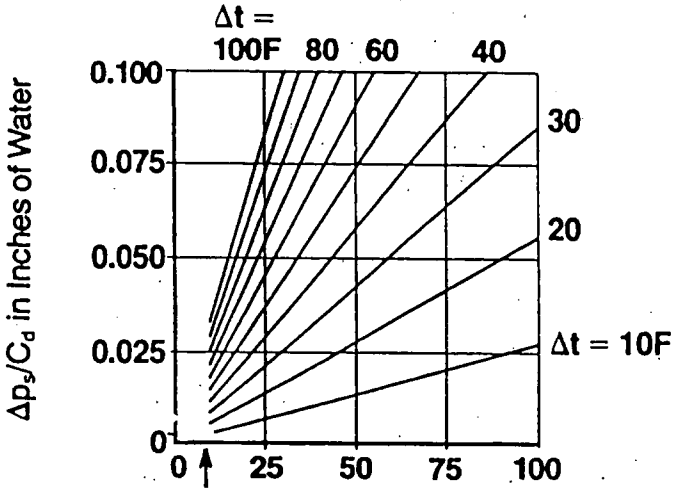

FIG. 2

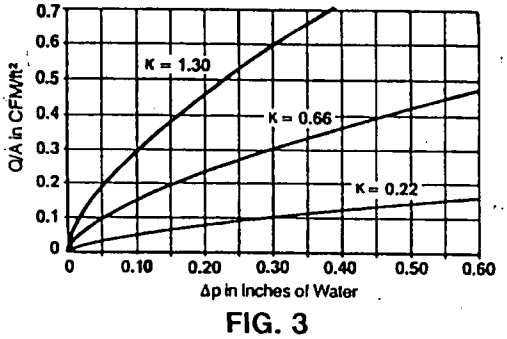

FIG. 3

BECHT ENGINEERING

K. Hovnanian Companies, Inc. 10 March 24, 1993

PROJECT # 932629	CLIENT: K. Hovnanian Co., Inc.	DATE: 3/2/93
CONTRACT: Plumbing and HVAC Investigation		

# 1504	ADDRESS: Cornwall Rd.	# 1505	ADDRESS: Cornwall Rd.
Poorly insulated around freon pipes at band joist. Voids in insulation at band joist. Band joist re-insulated as per new detail.		Existing hole in sheathing previously repaired with metal band, another smaller hole, voids in insulation at band joist, plumbing pipes near exterior wall.	
# 1509	ADDRESS: Cornwall Rd.	# 1307	ADDRESS: Paddington Ct.
Fireplace chase without chimney, sheathing missing, poorly insulated. Band joist re-insulated as per new detail.		Band joist insulated with R-11, hole in sheathing. Band joist re-insulated as per new detail.	
# 1309	ADDRESS: Paddington Ct.	# 1003	ADDRESS: Crown Ct.
Insulated as specified on Architectural Plans. Band joist re-insulated as per new detail.		Hole in sheathing, poorly insulated around freon pipes, voids in insulation. Band joist re-insulated as per new detail.	
# 1508	ADDRESS: Cornwall Rd.	# 1004	ADDRESS: Crown Ct.
Tyvek on gas meter closet installed incorrectly. Band joist re-insulated as per new detail.		Band joist insulated with a mixture of R-11 and R-13. Re-insulated as per new detail.	
# 1017	ADDRESS: Crown Ct.	# 1494	ADDRESS: Cornwall Rd.
Unit with kitchen box window, no insulation at ceiling. Unit has a garage; band joist poorly insulated. Band joist re-insulated as per new detail.		Unit with gas meter closet, missing sheathing, insulation voids. Band joist re-insulated as per new detail.	
# 1062	ADDRESS: Cambridge Ct.	#	ADDRESS:
Sprinkler pipe in cathedral ceiling burst, access was repaired, could not inspect pipe, witnessed water damage.			

INSPECTOR: SEAN TURNQUIST	PAGE 1A OF 1

BECHT ENGINEERING

PROJECT # 932629	CLIENT: K. Hovnanian Co., Inc.	DATE: 3/3/93
CONTRACT: Plumbing and HVAC Investigation		

# 1503	ADDRESS: Cornwall Rd.
Poor band joist insulation, many voids, plumbing pipes near exterior walls. Band joist re-insulated as per new detail.	
# 1494	ADDRESS: Cornwall Rd.
Insulated as per architectural details. Re-insulated as per new detail. Unit has fire-place chase with no flue sheathed correctly. Re-insulated as per new detail.	
# 1012 to 1015	ADDRESS: Crown Ct. (Courtyard Area)
Voids in insulation, holes in sheathing. Re-insulated as per new details.	
# 1045	ADDRESS: Cambridge Ct.
Second floor unit - sprinkler pipe froze in cathedral ceiling. Access to pipe was repaired prior to inspection.	
#	ADDRESS:

# 1505	ADDRESS: Cornwall Rd.
Unit has kitchen box window, poorly insulated above ceiling, sheathing loosely nailed. Re-insulated as per new detail.	
# 1004 to 1011	ADDRESS: Crown Ct. (Courtyard Area)
Courtyard repaired before with Dowboard insulation on exterior in soffit, holes in sheathing, voids in insulation, R-11 at band joists, re-insulated as per new details.	
# 1044	ADDRESS: Cambridge Ct.
First floor unit - water damage from second floor fireplace chase. Very cold, drafty, see daylight through cracks.	
#	ADDRESS:
#	ADDRESS:

INSPECTOR: SEAN TURNQUIST	PAGE 1B OF 1

BECHT ENGINEERING

PROJECT # 932629	CLIENT: K. Hovnanian Co., Inc.	DATE: 3/4/93
CONTRACT: Plumbing and HVAC Investigation		

# 1044	ADDRESS: Cambridge Ct.	#	ADDRESS:
First floor unit - 24" stud cavity insulated with 16" wide insulation (8" of exterior wall not insulated). No sheathing or insulation at band joist in floor truss (truss is exposed to uninsulated fireplace chase, no insulation above fireplace chase in living areas).			
#	ADDRESS:	# 1307	ADDRESS:
#	ADDRESS:	#	ADDRESS:
#	ADDRESS:	#	ADDRESS:
#	ADDRESS:	#	ADDRESS:
		INSPECTOR: SEAN TURNQUIST	PAGE 1C OF 1

BECHT ENGINEERING

PROJECT # 932629	CLIENT: K. Hovnanian Co., Inc.	DATE: 3/8/93
CONTRACT: Plumbing and HVAC Investigation		

# 1044	ADDRESS: Cambridge Ct.	#	ADDRESS:
First floor unit - opened gypsum ceiling, boxed out fireplace flue for fireplace as per recommendation #1. Someone insulated chimney without maintaining clearances, Tom Mazza is aware.			
#	ADDRESS:	# 1307	ADDRESS:
#	ADDRESS:	#	ADDRESS:
#	ADDRESS:	#	ADDRESS:
#	ADDRESS:	#	ADDRESS:
#	ADDRESS:	#	ADDRESS:

INSPECTOR: SEAN TURNQUIST	PAGE 1D OF 1

BECHT ENGINEERING

K. Hovnanian Companies, Inc. 14 March 24, 1993

PROJECT # 932629	CLIENT: K. Hovnanian Co., Inc.	DATE: 3/9/93
CONTRACT: Plumbing and HVAC Investigation		

# 1488	ADDRESS: Cornwall Rd.	# 1492	ADDRESS: Cornwall Rd.
Band joist insulated with R-11 at rear and back of building. Band joist re-insulted as per new detail.		Unit with box kitchen window, no insulation on band joist. Re-insulate as per new details.	
# 1494 & 1495	ADDRESS: Cornwall Rd.	# 1497	ADDRESS: Paddington Ct.
Over entrance doors with large overhang, no insulation just sheathing. Re-insulate as per new detail.		Holes in sheathing, voids in insulation. Band joist re-insulated as per new detail.	
# 1002	ADDRESS: Paddington Ct.	# 1010	ADDRESS: Crown Ct.
Above entrance door R-11 at band joist, unit has box window with R-11 at band joist. Re-insulated as per new detail.		Above entrance door, firewall with R-13. Re-insulated as per new detail.	
#	ADDRESS:	#	ADDRESS:
#	ADDRESS:	#	ADDRESS:
# 1062	ADDRESS: Cambridge Ct.	#	ADDRESS:

INSPECTOR: SEAN TURNQUIST	PAGE 1E OF 1

BECHT ENGINEERING

PROJECT # 932629	CLIENT: K. Hovnanian Co., Inc.	DATE: 3/22/93
CONTRACT: Plumbing and HVAC Investigation		

# 1044 & 1045	ADDRESS: Cambridge Ct.	# 1053	ADDRESS: Cambridge Ct.
Gained access to second floor chase through exterior soffit, limited space to work, flex duct over 14' long.		Plumbing pipes (copper, PVC, CPVC) next to exterior wall. Unit over garage, voids in insulation. Band joist re-insulated as per new detail.	
# 1054	ADDRESS: Cambridge Ct.	# 1064	ADDRESS: Cambridge Ct.
Above entrance door - voids in insulation. On bay window - Tyvek missing, voids in insulation. Installed new Tyvek and re-insulated as per new detail.		Band joist with R-13, voids around freon piping. Re-insulated as per new detail.	
# 1068	ADDRESS: Cambridge Ct.	# 1069	ADDRESS: Cambridge Ct.
Holes in sheathing, voids in insulation. Band joist re-insulated as per new detail.		Courtyard area - band joist with R-13, no insulation on 5' x 4' area of ceiling on exterior wall, voids in insulation . Gas meter closet - voids in insulation. Re-insulated as per new detail.	
#	ADDRESS:	#	ADDRESS:
		.	
#	ADDRESS:	#	ADDRESS:

INSPECTOR: SEAN TURNQUIST	PAGE 1F OF 1